Abstract View

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The Relationship between Vertical, Diapycnal, and Isopycnal Velocity and Mixing in the Ocean General Circulation

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ABSTRACT

On ocean general circulation scales, vertical velocity w is extremely small, O(10^{-5}) smaller than the horizontal velocity in scale. Nevertheless, it is of great importance to advective–diffusive and vorticity balances. In order to better understand the relationship between the cross-isopycnal (diapycnal) velocity, the mixing, and w, in a nonideal ocean in which some mixing and density sources are present, the velocity vector is decomposed into isopycnal and diapycnal components. Applying this decomposition to the exact continuity (mass conservation) equation, it is shown that while the diapycnal divergence is in principle the first correction to the isopycnal divergence for general circulation scales, the observational uncertainties in the isopycnal velocity are large enough that the diapycnal divergence cannot in practice be determined. Using these results, the horizontally averaged near-vertical (diapycnal) velocity computed by Wunsch et al. in a model of the South Pacific (28–43°S) is reconsidered. It is shown that the calculation of diapycnal velocity from isopycnal mass convergence is not consistent with uncertainties in the isopycnal velocity and that the implied mixing cannot be accounted for with simple diffusion models and salt-fingering alone.